Level 1 Landscape Assessment of New Hampshire's Wetlands

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Prior Situation

- NHDES Comprehensive Monitoring Strategy for surface waters did not address wetlands
- Little to no monitoring information
- No workable assessment units
- No wetland assessments in 2006 305(b) 303(d) report to EPA/Congress

EPA Elements of a State Water Monitoring and Assessment Program for Wetlands

Level 1- Landscape Assessment

GIS based assessment of landscape development indices – used to characterize the buffers that surround wetlands

Level 2 – Rapid Wetland Assessment

Evaluate the general condition of individual wetlands using relatively simple field indicators

Level 3- Intensive Site Assessment

Biological monitoring/assessment

Project Goals and Objectives

- Create wetland assessment units
- Create a buffer area around each wetland assessment unit that can be analyzed to determine what landscape types comprise the buffers.
- Create an index to assess the ecological integrity of the buffer areas based on the relative impact of each of the landscape types identified in the buffers.
- Identify a “good/bad” threshold between potentially supporting and potentially not supporting for the aquatic life designated use.
- Evaluate the condition of the wetland buffer, apply the index of ecological integrity, and determine potential aquatic life use support status.
- Summarize the results of the analysis and include the results in the 2008 305(b) report.

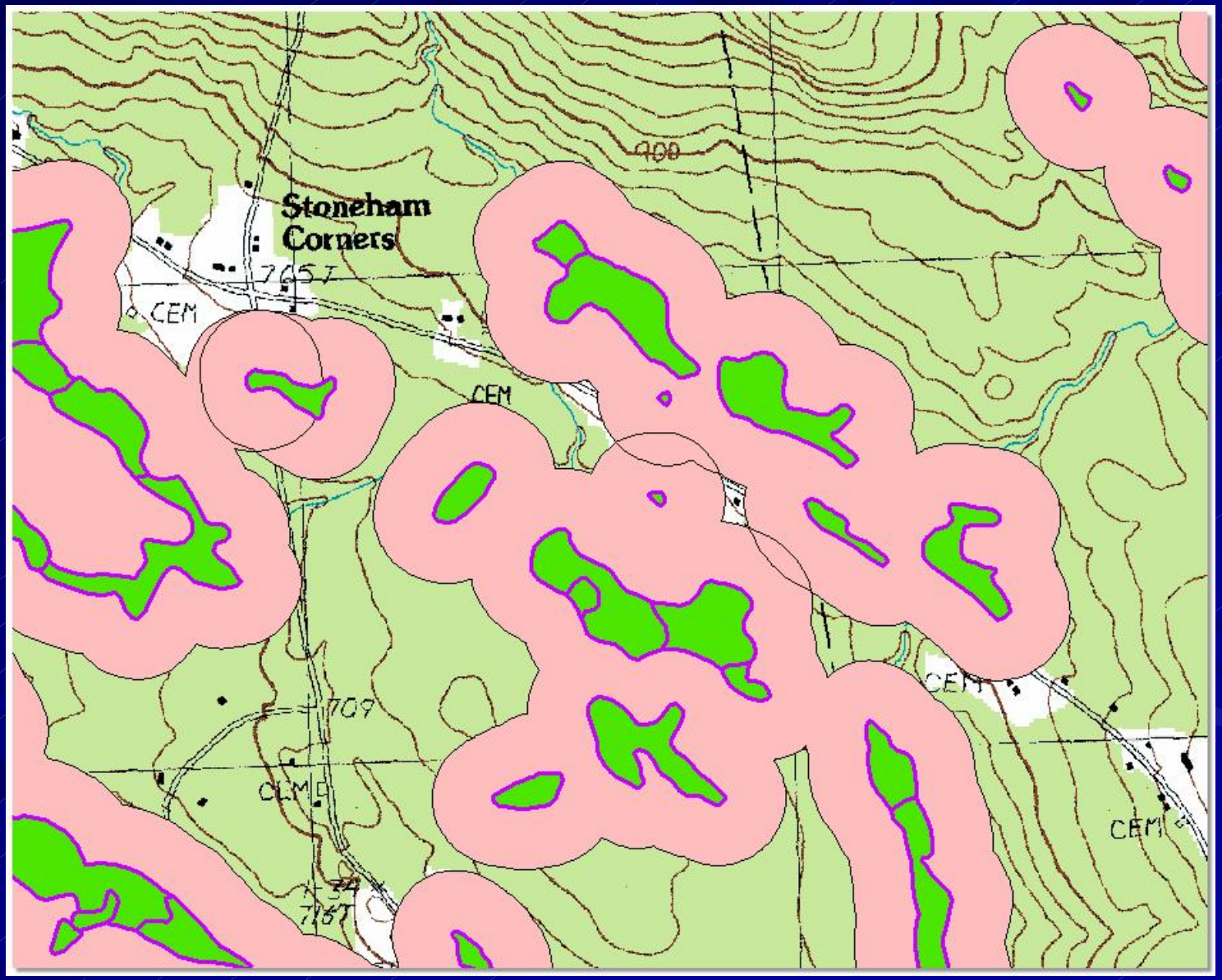
Creating Assessment Units

- National Wetlands Inventory (NWI) Polygons as a base
- Amalgamation of NWI Polygons into Assessment Units (AUs) – Use NH Fish and Game's Wildlife Action Plan as guide
- Buffers on AU Amalgamations for Landscape Level Assessments

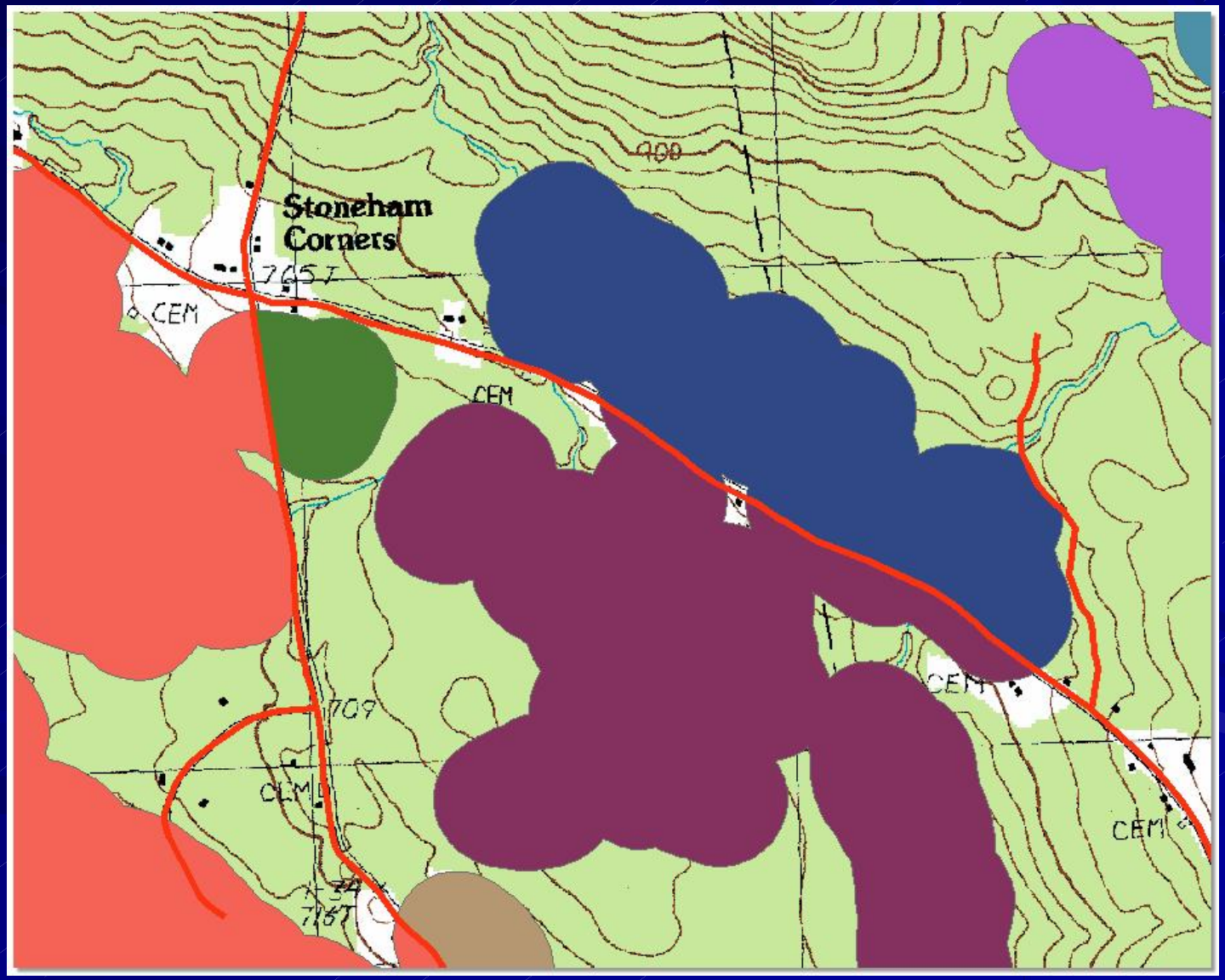
Converting NWI Polygons into Assessment Units

- Trim out all Lacustrine/Limnetic, Palustrine/Open Water, Marine/Subtidal, Estuarine/Subtidal, and Riverine polygons
- Buffer all NWI polygons at 125m – intended to reflect the distance at which biological communities are likely overlapping and traveling between individual NWI polygons
- Merge touching buffers so that those NWI polygons within 250m can be coded as within a single buffer complex
- Split any polygon bisected by a road
- Split any polygon bisected by a HUC12 divide
- Assign unique AUIDs based upon HUC12 to the split buffer complexes
- Assign each AUID to one or more, full or partial NWI polygon as to maintain polygon level Cowardin Code

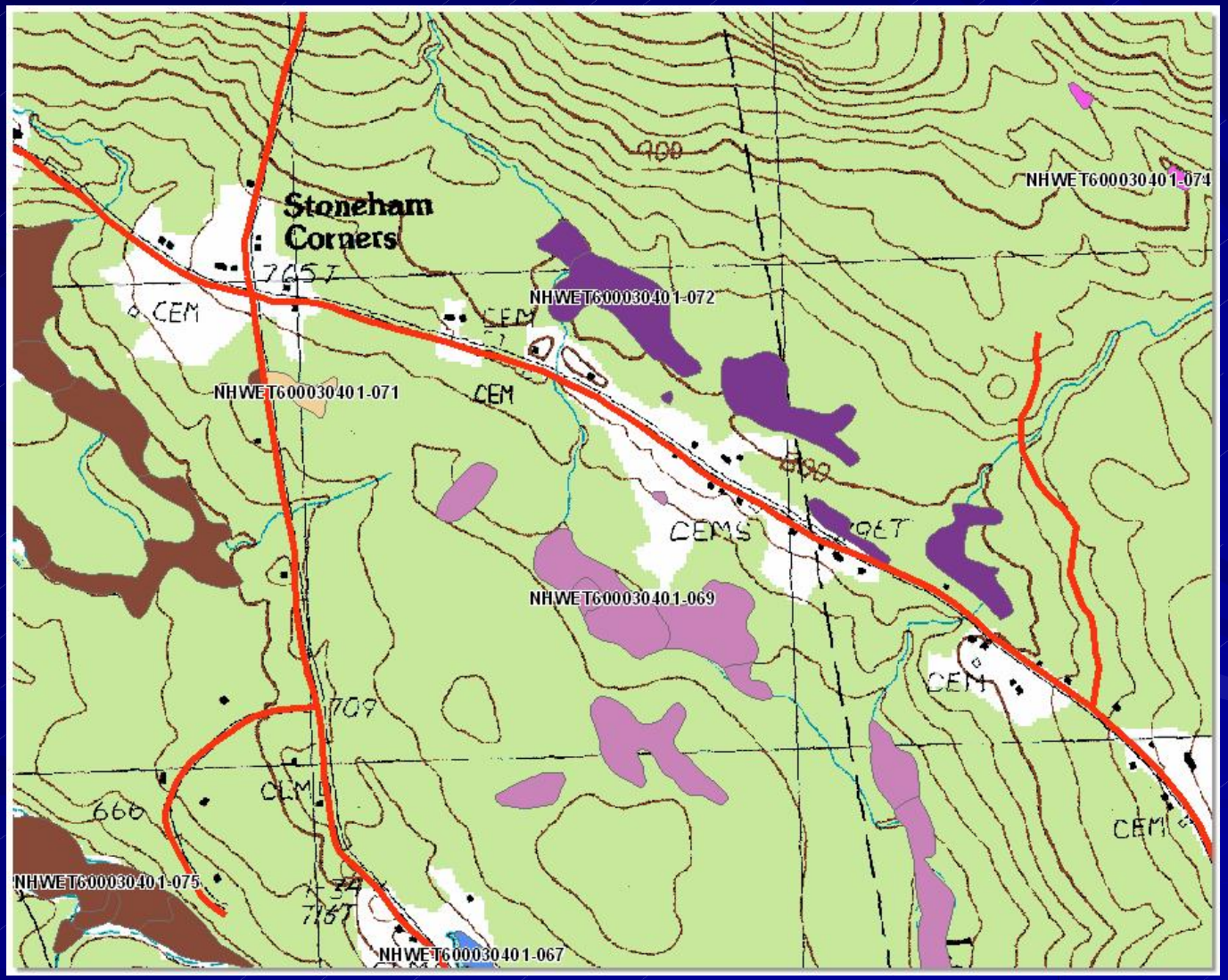
NWI Buffered



Resulting AUID Buffer Complex Areas



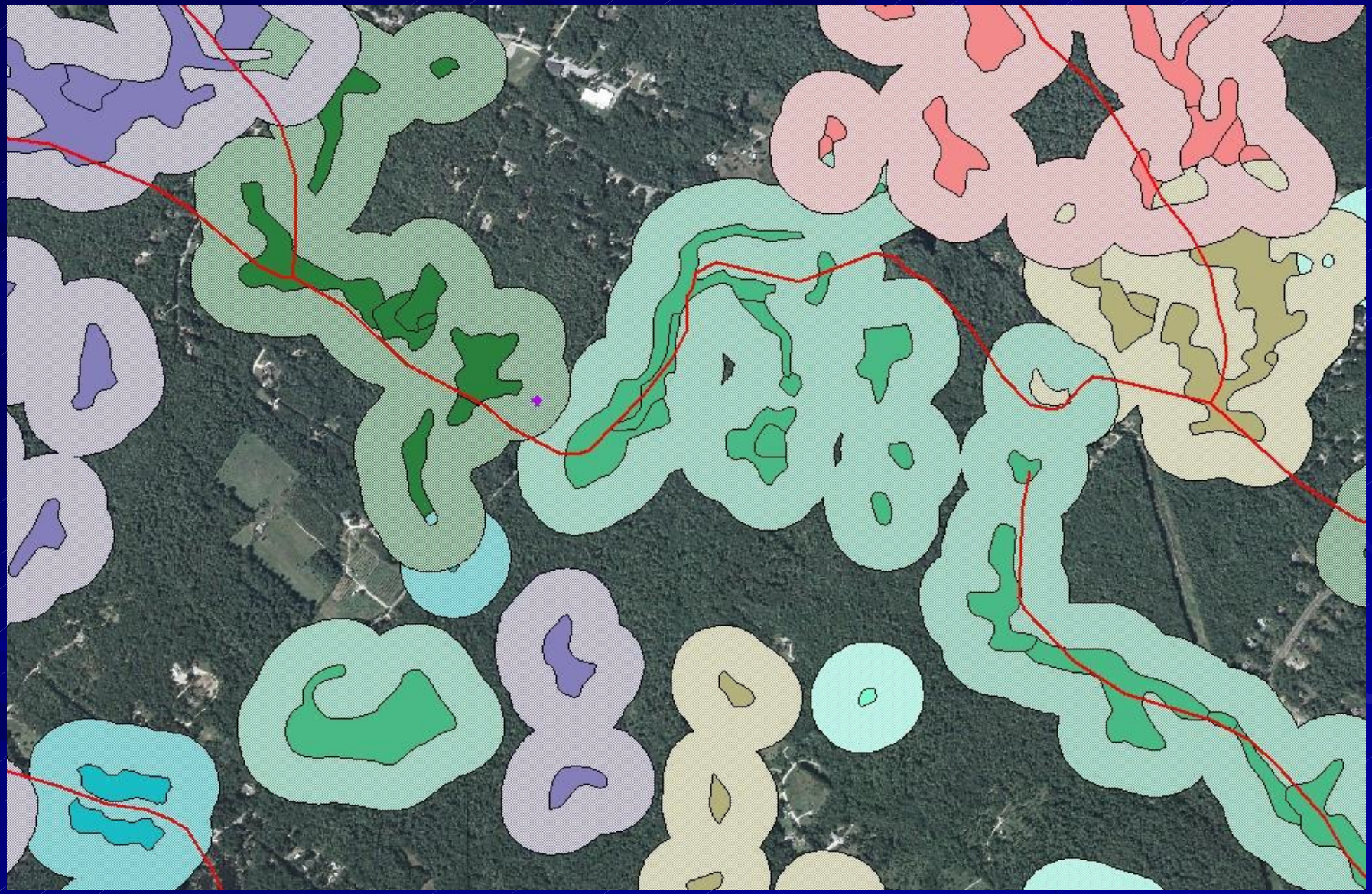
Resulting Assessment Unit IDs (n=23,626) Cowardin Coding Retained



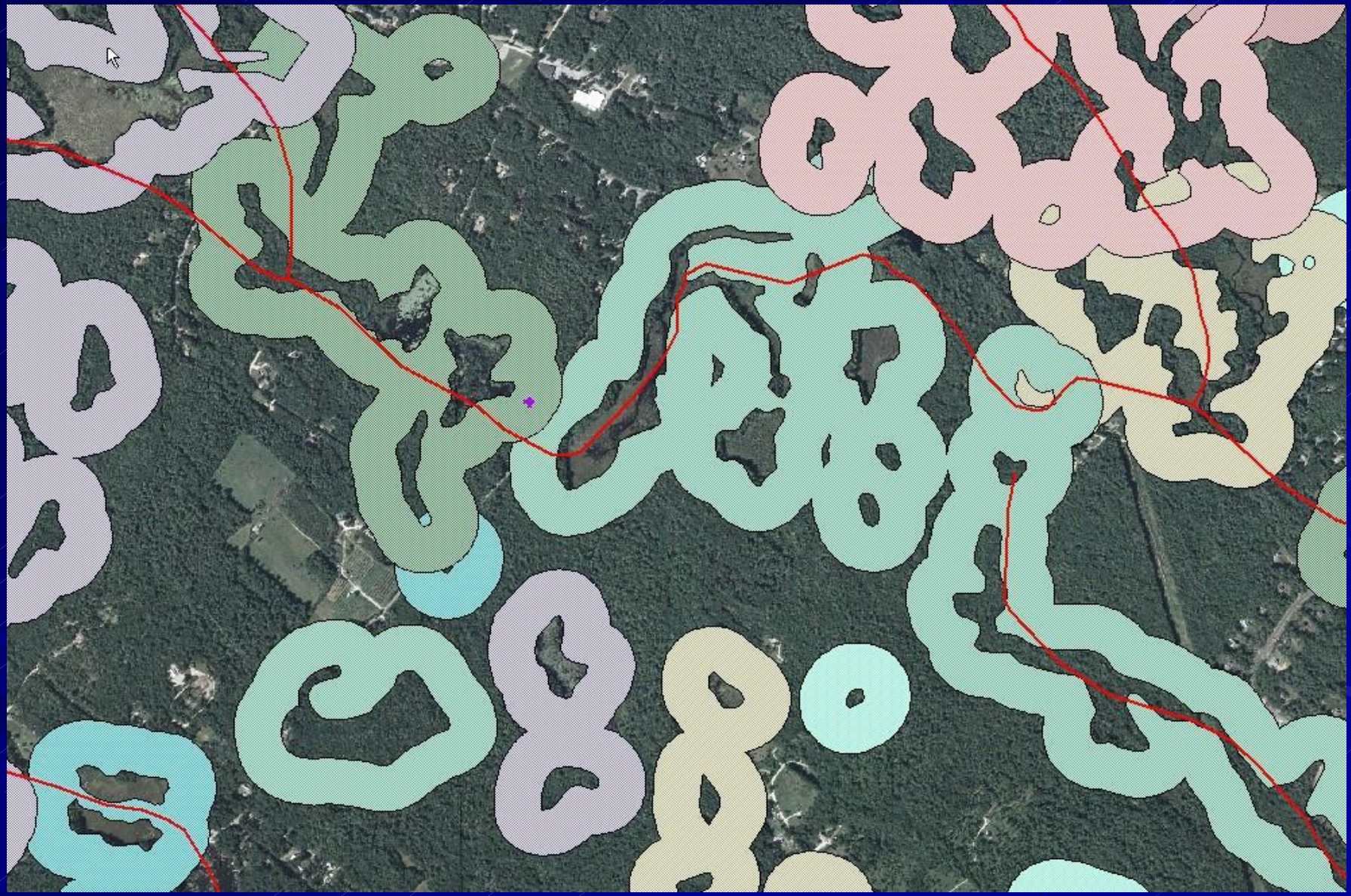
Create Second Buffer Set for Landscape Level Assessments

- 125m buffer around all assessment units
- Ignore HUC 12 divides and road bisects used to create initial assessment units
- Buffer evaluated for factors other than just “water quality”

Re-buffer Assessment Units



Remove Assessment Units



Classification of Buffer Landcover Types

- National Landcover Data – Based on Landsat Thematic Mapper Imagery (30m resolution) – collected June 1999 through October 2003.
- Use GIS to tell us what % of each land cover class comprises a given buffer.

NLCD Land Cover Class Definitions

General Group	Code	Detailed Class
Developed	2	High Intensity Developed
Developed	3	Medium Intensity Developed
Developed	4	Low Intensity Developed
Developed	5	Open Spaces Developed
Active agricultural land	6	Cultivated Land
Active agricultural land	7	Pasture/Hay
Active agricultural land	8	Grassland
Forested	9	Deciduous Forest
Forested	10	Evergreen Forest
Forested	11	Mixed Forest
Forested	12	Scrub/Shrub
Wetlands	13	Palustrine Forested Wetland
Wetlands	14	Palustrine Scrub/Shrub Wetland
Wetlands	15	Palustrine Emergent Wetland

NLCD Land Cover Class Definitions

- **Developed, Medium Intensity** - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50 to 80 percent of the total cover. These areas most commonly include single-family housing units.

- **Developed, High Intensity** - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

- **Cultivated Crops** - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

Pittsburg – Likely Low Impact

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Portsmouth – Likely High Impact

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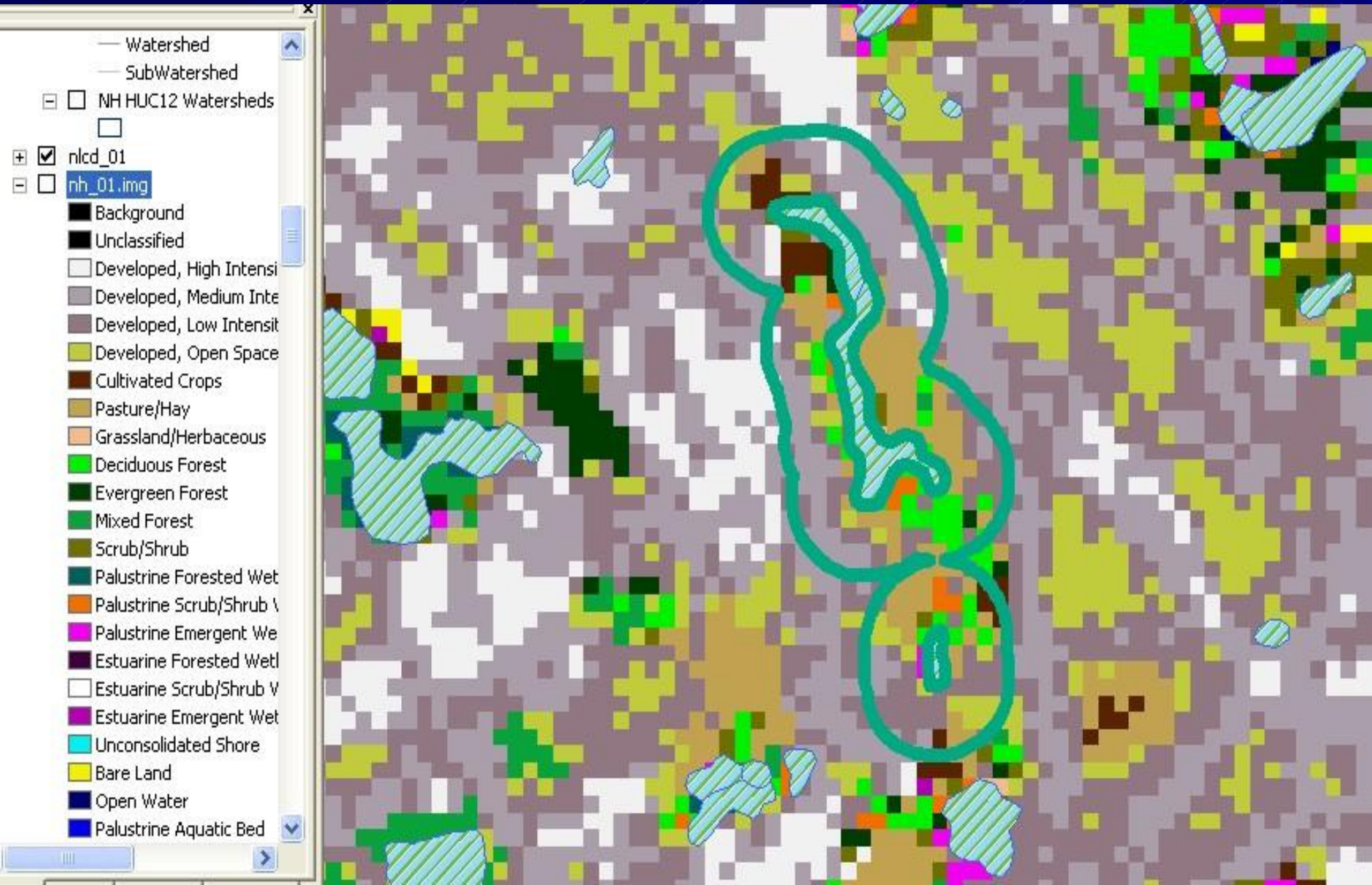


Determine % of Each Landscape Type

Portsmouth

- 40% Developed – Med. Density
- 20% Developed – Low Density
- 15% Pasture/Hay
- 10% Developed – High Intensity
- 10% Developed – Open Space
- 3% Palustrine – Scrub/Shrub
- 2% Estuarine – Emergent

Pittsburg

- 60% Deciduous Forest
- 35% Mixed Forest
- 5% Pasture/Hay

Evaluation of Wetland Buffers

- Assess for “aquatic life” designated use
- Identify those wetlands that are likely or unlikely to provide suitable conditions for supporting a balanced, integrated, and adaptive community of aquatic flora and fauna
- Assessments to be based on an evaluation of the 125m buffers not the wetlands themselves
- No definitive support categories will be made due to the inherent roughness of this exercise.

  -potentially supporting

  -potentially not supporting

Weighting Impacts of Land Cover Classes
Center for Watershed Protection – The Simple Method

- Designed to estimate stormwater runoff, pollutant loading, and resulting impacts to the ecological integrity of 1st through 3rd order streams
- Reasonable to concur that the ecological integrity of wetlands will also degrade as impervious surface cover and pollutant loads increase
- For each NLCD landcover type an annual pollutant load was calculated for numerous parameters
- Assign % impervious cover to each land use – a range of % impervious cover is given for each NLCD land cover class

Event Mean Concentration Values (mg/L)

Pollutant	Agriculture/ Pasture	Forest Rural Open	Highway	Industrial	High Intensity Developed
BOD (mg/L)	5.5	3.0	17	15.3	18.3
COD (mg/L)	53	36.5	103	85	86.7
TSS (mg/L)	142.5	77.5	141.5	110.3	101.0
TDS (mg/L)	415	415	294	202	203.5
TP (mg/L)	0.705	0.12	0.39	0.24	0.3
DP (mg/L)	0.09	0.035	0.22	0.43	0.2
TKN (mg/L)	1.64	0.825	1.8	2.08	1.9
NO2/3 (mg/L)	4.06	0.67	0.83	1.5	1.1
Pb (mg/L)		0.27	0.17	0.28	0.3
Cu (mg/L)			0.04	0.076	0.0
Zn (mg/L)		0.142	0.21	0.502	0.3
Cd (mg/L)			0.003	0.005	0.0
Fec. Coli	3250	300	600	1022	4578

Impervious Fraction

NLCD Landcover Type	% Impervious
High Intensity Developed	100
Medium Intensity Developed	80
Low Intensity Developed	50
Developed Open Space	20
Agriculture/Pasture	15
Forest/Rural/Open	0
Wetland/Water	0

Calculating Pollutant Loads for Landcover Types

$$L = 0226 * R * C * A$$

Where:

L = Annual Pollutant Load in lbs (convert mg/L event mean concentrations to lbs)

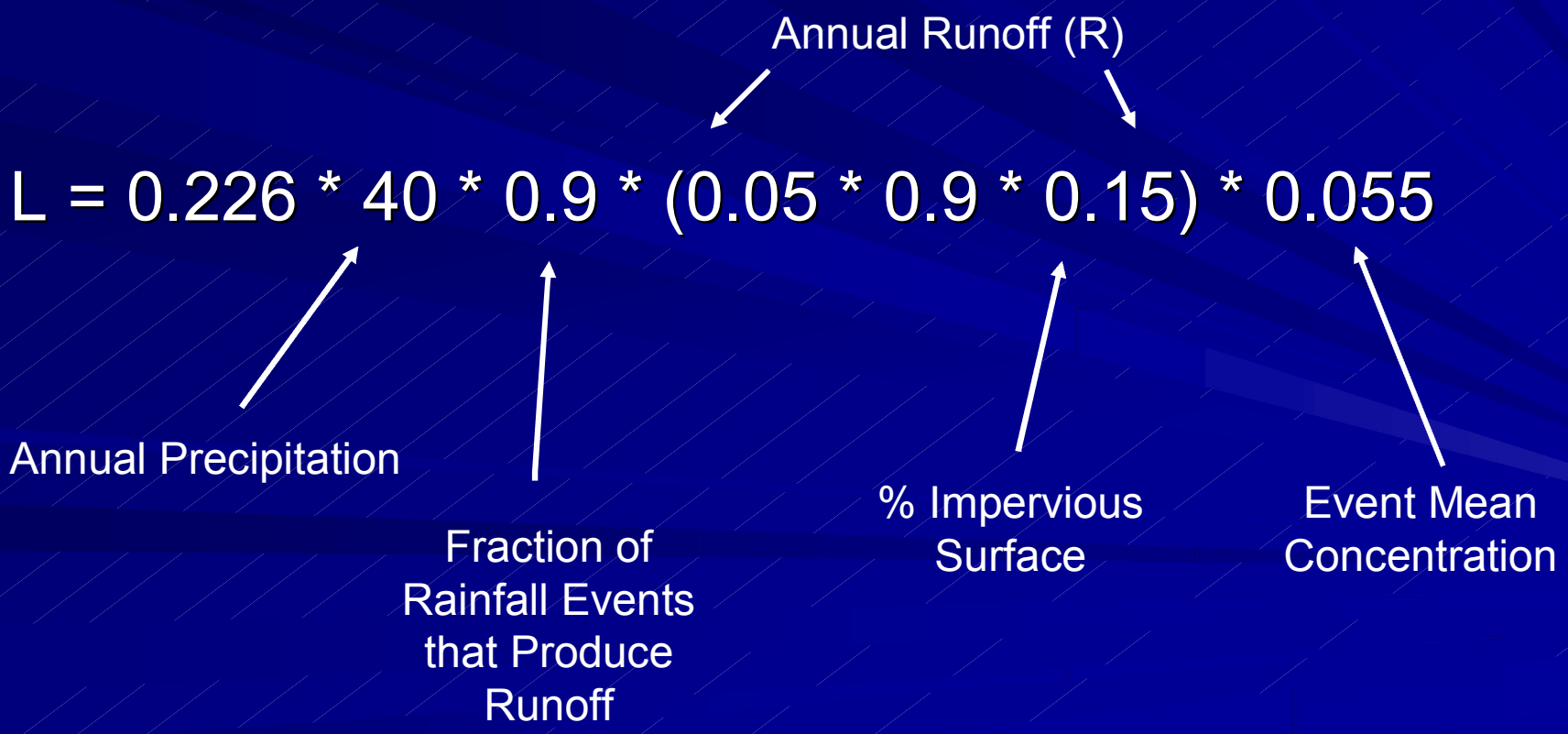
R = Annual Runoff

C = Pollutant Concentration

A = Acres

0.226 = unit conversion factor

Example: Total Phosphorus – Agriculture/Pasture



Annual Pollutant Loads (lbs/yr)

Pollutant	Agriculture/ Pasture	Forest Rural Open	Highway	Industrial	High Intensity Developed
TSS (mg/L)	214.5	31.5	1094	853	780.8
TP (mg/L)	1.1	0.1	3.0	1.9	2.5
TKN (mg/L)	2.5	0.3	13.9	16.1	15.0
NO2/NO3 (mg/L)	6.1	0.3	6.4	11.6	15.0

Determine Load Ration for Landcover Classes

Assumption: High Intensity Developed has the highest pollutant load based on 100 % Impervious Cover

$$\frac{\text{Pollutant Load}}{\text{Pollutant Load (High Intensity Dev)}} \times 100$$

Load Ratio (PL/PL High Intensity) X 100

Pollutant	Agriculture/ Pasture	Forest Rural Open	Highway	Industrial	High Intensity Developed
TSS (mg/L)	27	4	140	109	100
TP (mg/L)	43	2	121	74	100
TKN (mg/L)	16	2	93	107	100
NO2/NO3 (mg/L)	72	3	75	136	100

For further accuracy subtract the load ration of the landcover class “forested/rural open” from each load ratio. This removes background levels for each parameter.

	Forest Rural Open	Water Wetland	Ag/ Pasture	High Intensity Developed	Medium Intensity Developed	Low Intensity Developed	Developed Open Space
Imper/Fraction	0.00	0.00	0.15	1.00	0.79	0.49	0.20
Corrected Load Ratios							
BOD	1	1	6	100	80	52	9
CODTP	2	1	12	100	80	52	12
TSS	4	1	27	100	80	52	20
TDS	11	0	40	100	80	52	49
TP	2	1	43	100	80	52	15
DP	1	1	7	100	80	52	7
TKN	2	2	16	100	80	52	16
NO2/3	3	3	72	100	80	52	17
Pb	4	0	0	100	80	52	4
Cu	0	1	0	100	80	52	13
Zn	3	1	0	100	80	52	8
Cd	0	1	0	100	80	52	6
Fecal Col	0	0	14	100	80	52	17
E. coli	0			100	80	52	
Ratio Averages	**0**	**0**	**15.6**	**100**	**79.6**	**50.5**	**11.9**

Landcover Class “Scores”

Determining a threshold between Potentially Supporting (PS) and Potentially Not Supporting (PNS)

- Research conducted by NHDES Coastal Impervious Surface Mapping and the Center for Watershed Protection indicate that water quality violations are more likely when there is more than 10% impervious surface cover.

- If we assume the high density developed landcover class has 100% impervious surface than any wetland assessment unit with 10% or greater high density developed landcover class in the buffer would be listed as potentially not supporting.

Determining a threshold between Potentially Supporting (PS) and Potentially Not Supporting (PNS)

- Each landcover class is weighted against the high density developed landcover class
- Multiple the % each landcover class comprises of the buffer by the associated "score" for that landcover class

Assessment Score < 10 → Potentially Supporting

Assessment Score ≥ 10 → Potentially Not Supporting

Calculating Level 1 Assessment Score

Total *Score* = $\Sigma\ \%LC_i * LCS_i$

where:

%LC = percent of the total area in a given land cover class

LCS = Assessment score for given land cover class

Assessment Score < 10 → Potentially Supporting

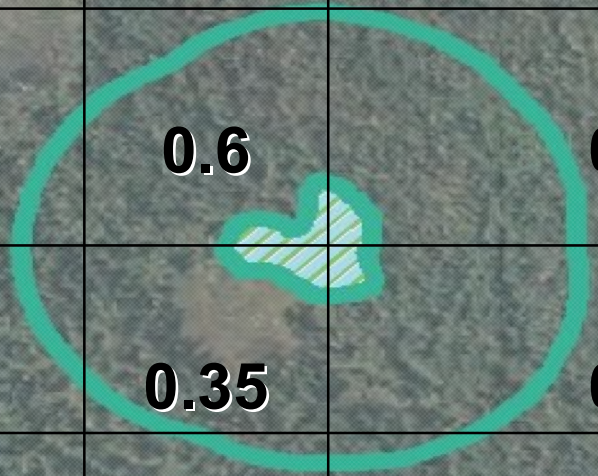
Assessment Score ≥ 10 → Potentially Not Supporting

Weighting Impacts of Land Cover Classes

Land Use	Level 1 Assessment Score	Impervious Cover Fraction	Threshold for PNS	% buffer occupied by Land Use @ PNS threshold **(threshold/score X 100)**
HID	100	1	10	10%
MID	79.6	0.79	10	13%
LID	50.5	0.49	10	20%
Dev Open	11.9	0.2	10	84%
Ag/Pasture	15.8	0.15	10	63%

Sample Assessment - Pittsburg

NLCD Landcover Class	Fraction	Land Cover Class Assessment Score	Total Score
Deciduous Forest	0.6	0	0
Mixed Forest	0.35	0	0
Pasture/Hay	0.05	15.8	0.79
Potentially Supporting			0.79



Sample Assessment - Portsmouth

NLCD Landcover Class	Fraction	Land Cover Class Assessment Score	Total Score
Developed - Medium	0.4	76.6	30.64
Developed - Low	0.2	50.5	10.1
Pasture/Hay	0.15	15.8	2.37
Developed - High	0.10	100	10.0
Developed – Open Space	0.05	11.9	0.60
Palustrine – Scrub/Shrub	0.06	0	0
Estuarine - Emergent	0.04	0	0
Potentially Not Supporting			53.61

Level 1 Wetland Assessment Results Completed for the 2008, 305(b) Report

Wetland Assessment Units (2008)

Level 1 Assessment Results

- Insufficient Information - Potentially Attaining Standards (3-PAS)
- Insufficient Information - Potentially Not Supporting Standards (3-PNS)
- Town Boundaries

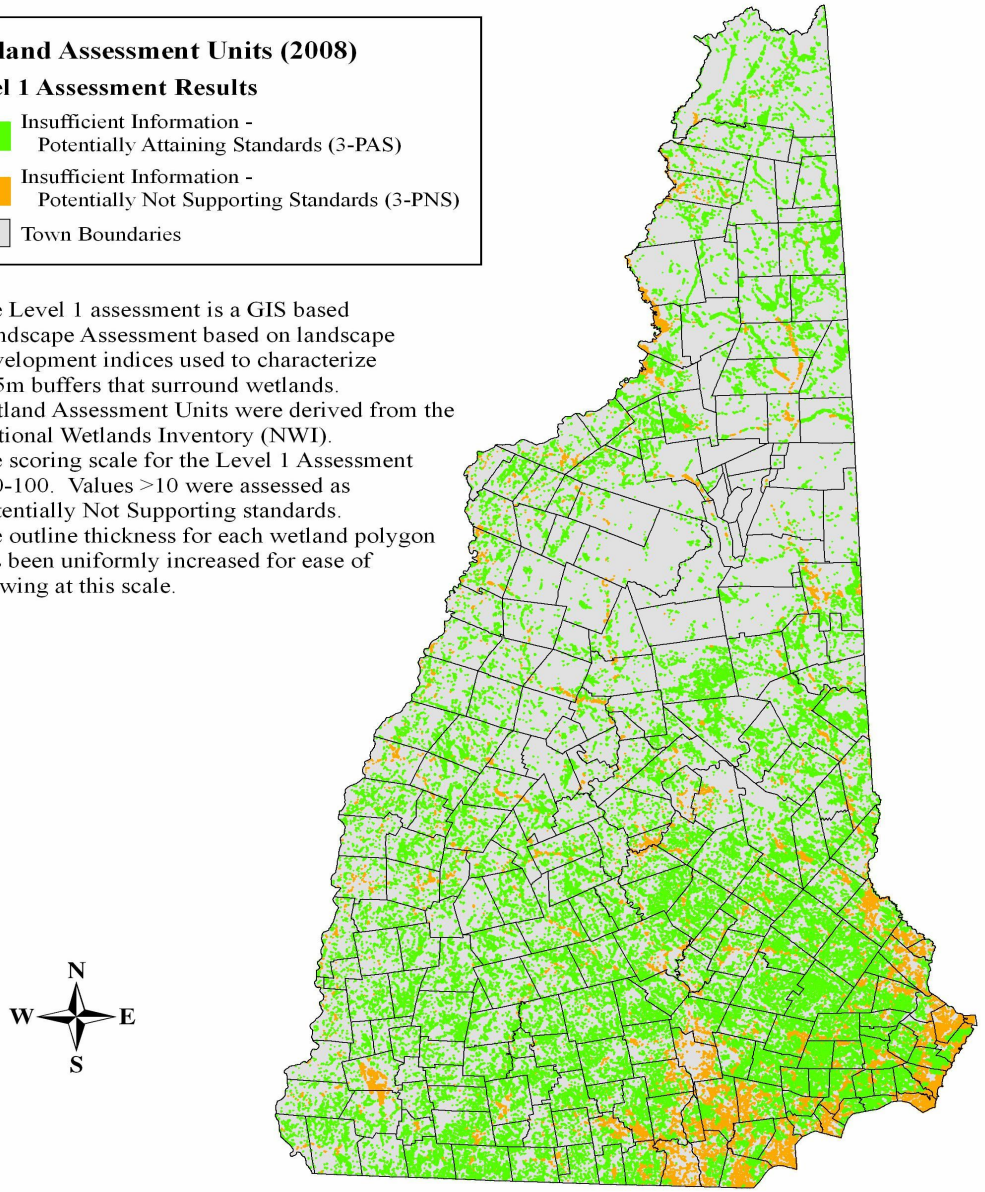
Notes:

1 - The Level 1 assessment is a GIS based Landscape Assessment based on landscape development indices used to characterize 125m buffers that surround wetlands.

2 - Wetland Assessment Units were derived from the National Wetlands Inventory (NWI).

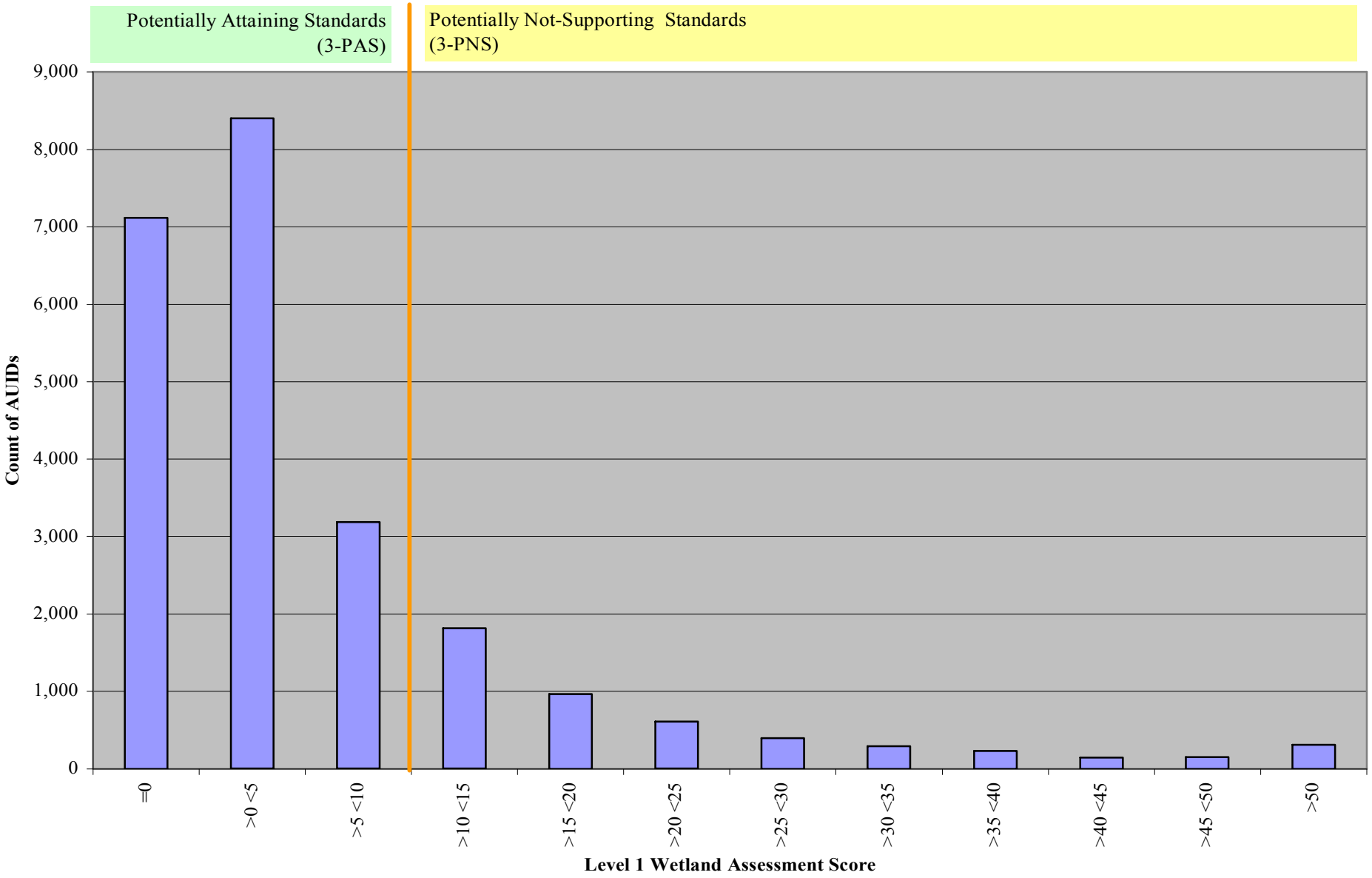
3 - The scoring scale for the Level 1 Assessment is 0-100. Values >10 were assessed as Potentially Not Supporting standards.

4 - The outline thickness for each wetland polygon has been uniformly increased for ease of viewing at this scale.

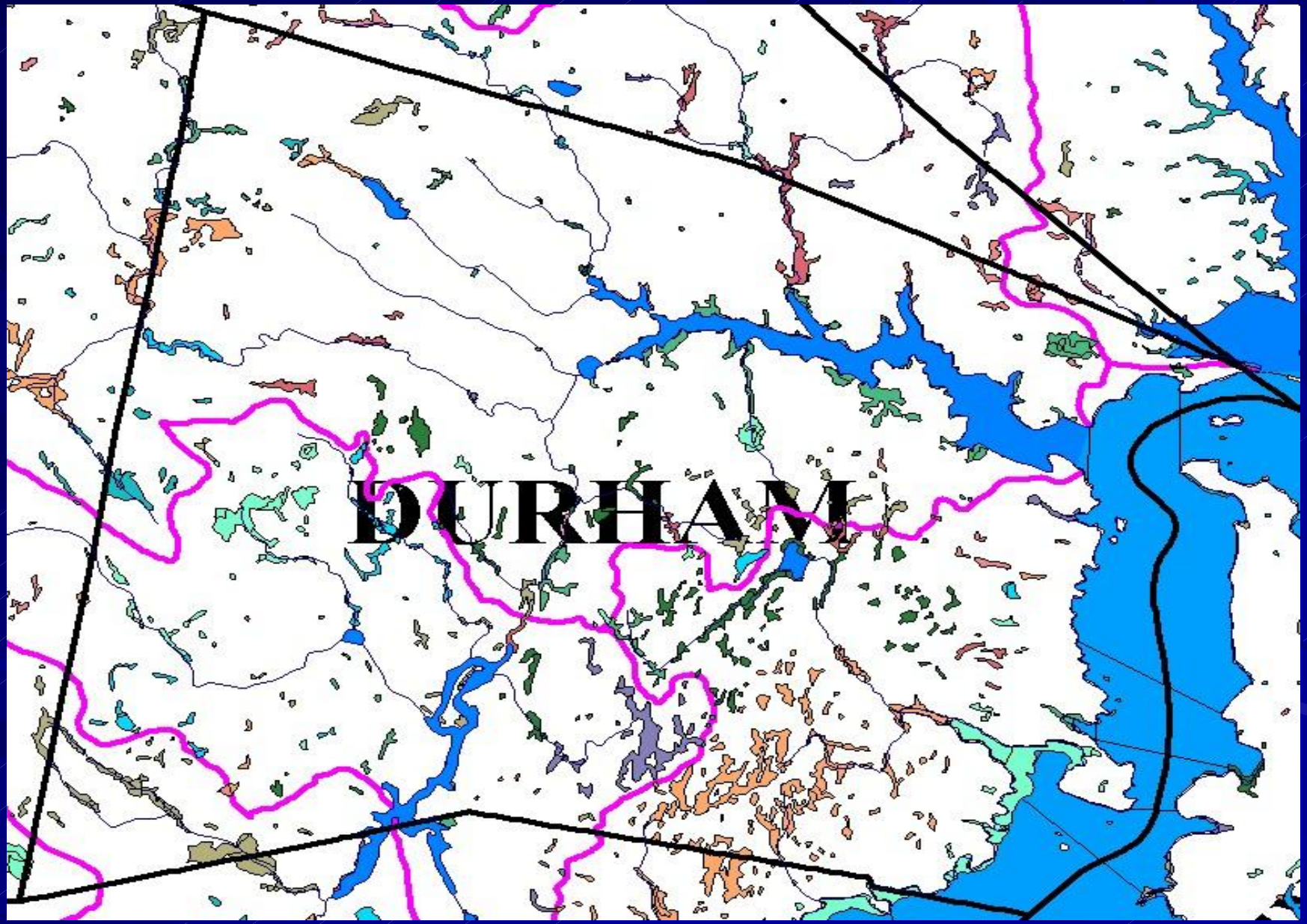


Map Document: (H:\Water Quality\305(B)-303(D) PROGRAM\2008\Data_and_Doc\Data_Rcvd\Wetlands\Level1_Assmnts.mxd) 9/12/2008

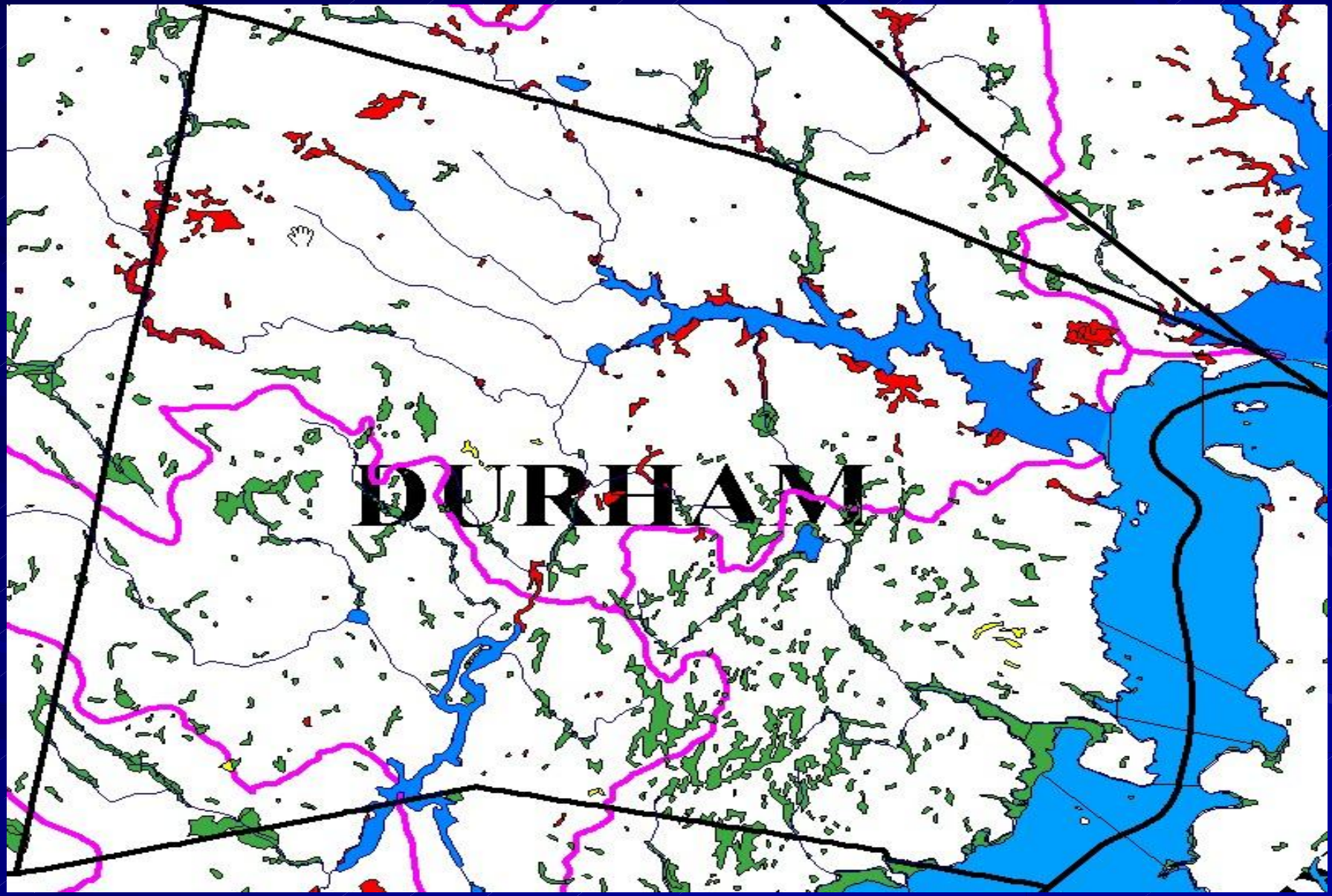
Distribution of Level 1 Assessment Scores



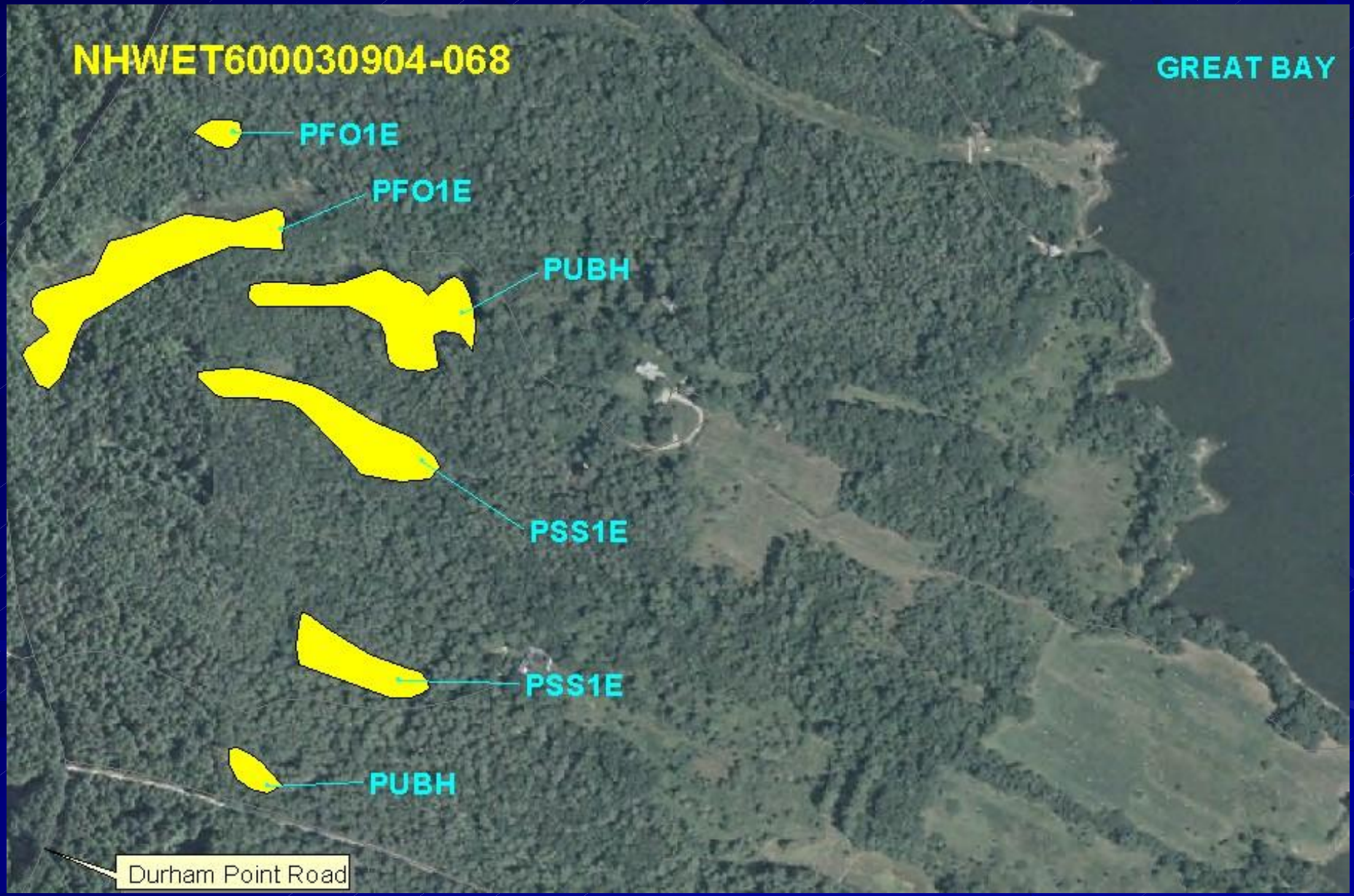
Identifying Assessment Status of Wetlands



Identifying Assessment Status of Wetlands



Identifying Undisturbed Wetlands



Next Steps

- Provide information to watershed and volunteer groups
- Provide wetland assessment GIS layers to GRANIT
- Conduct field verifications
- Begin process of developing Level II methods
- Continue partnering with other agencies involved in wetlands (Fish and Game, Natural Heritage Bureau, EPA, NEIWPCC, ect.)

Coming Soon

- EPA and States are in the process of planning a national assessment of wetlands – field work schedule for 2011.
- VHB has developed a Level 1 assessment model to identify mitigation sites as part of the Merrimack – run on a statewide level
- Natural Heritage Bureau has received a grant to conduct work on wetland assessments.
- Develop Level II and II methods that can be linked to the water quality standards and the CALM
- Incorporate updated version of the New Hampshire Method of wetland evaluation

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